

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

In the Matter of)
)
Allocation of Spectrum in the 5 GHz Band)
To Establish a Wireless Component of the)
National Information Infrastructure)

RM-8653

In the Matter of)
)
Petition for Rulemaking to Allocate)
the 5.1 - 5.35 GHz Band and Adopt)
Service Rules for a Shared Unlicensed)
Personal Radio Network)

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RM-8648

COMMENTS OF APPLE COMPUTER, INC.

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SUMMARY

In May, 1995, Apple Computer and WINForum each submitted petitions requesting that the FCC allocate spectrum in the 5 GHz range for a new unlicensed, high-speed, wireless data communications service. The Petitions are based upon a simple premise: unlicensed wireless communications are fundamentally different from any wired or licensed-wireless service and must be integrated into the National Information Infrastructure (the "NII") if the NII is to develop a full range of communications applications capable of serving users across the nation, across income levels, and in all walks of life.

The NII will combine different technologies and services which, together, will be capable of serving individuals' varied communications requirements. Individual communications will rely on different technologies and services to create an end-to-end link, and individuals themselves will rely on different technologies at different times. Wireless technologies — and, in particular, unlicensed wireless options — must be a part of this mix. If unlicensed services are not permitted to develop, users will be left with an inadequate choice of technologies, and some users may find themselves bypassed by the NII.

Demand for unlicensed wireless services will be sufficient to justify a range of allocations, each with different attributes, hence, different capabilities. The proposed 5 GHz unlicensed band would complement other existing and proposed unlicensed wireless options and, together with them, would create a set of alternatives able to satisfy a range of different communications requirements.

In light of the benefits a 5 GHz unlicensed allocation could bring to users — in particular, those whose needs may not adequately be served by other communications options — the Commission should act promptly to adopt an NPRM, as proposed in the Petitions. Prompt action is required to ensure that NII Band devices are available in a timely manner to meet the growing demand for high-bandwidth connections and wireless community networks, and to promote U.S. technological leadership and assure that the United States is not left in a "catch-up" position with respect to European HIPERLAN developments.

The NPRM should reflect the many areas of agreement between Apple and WINForum, in particular:

- The need for a 5 GHz allocation with sufficient spectrum to support broadband applications, including high-speed data, voice, graphics, teleconferencing, videoconferencing, and multimedia applications, via both *ad hoc* and wireless network connections;
- A requirement that transmissions should be limited to data encapsulated in packetized form;
- The use of an appropriate, representative industry body to develop NII Band "rules of the road" that minimize interference and promote spectrum sharing.

The NPRM also should provide for "Part 16" operation, using the model previously developed for Data-PCS, should require that the spectrum resource be shared equitably by all users, should authorize transmitters power levels of up to one watt, and should permit the use of both omnidirectional and directional antennas without limits on EIRP. Finally, the NPRM should request comment from existing and planned users of the 5 GHz band to ensure that, if a risk of harmful interference to any such users exists, mutually acceptable sharing solutions can promptly be developed.

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COMMENTS OF APPLE COMPUTER, INC.

In May, 1995, Apple Computer, Inc. ("Apple") and the Wireless Information Networks Forum ("WINForum") each submitted petitions (the "Petitions") requesting that the Federal Communications Commission ("FCC" or "Commission") allocate spectrum in the 5 GHz range for a new unlicensed, high-speed, wireless data communications service. The Petitions are based upon a simple premise: unlicensed wireless communications are fundamentally different from any wired or licensed-wireless service and must be integrated into the National Information Infrastructure (the "NII") if the NII is to develop a full range of communications applications capable of serving users across the nation, across income levels, and in all walks of life.

The Petitions reflect the Commission's recent decisions allocating spectrum for unlicensed Data-PCS and unlicensed voice PCS, as well as the Commission's decisions to retain the 2400-2483.5 MHz and 902-928 MHz bands for unlicensed services.¹ These decisions recognize the crucial role of unlicensed wireless communications in the overall telecommunications infrastructure and the importance of protected, "Part 16" unlicensed operation by, for the first time,

¹ Amendment of the Commission's Rules to Establish New Personal Communications Services, Memorandum Opinion and Order, GEN Docket No. 90-314, 9 FCC Rcd 4957 (1994); Allocation of Spectrum Below 5 GHz Transferred from Federal Government Use, First Report and Order and Second Notice of Proposed Rulemaking, ET Docket No. 94-32, 10 FCC Rcd 4769 (1995); Amendment of Part 90 of the Commission's Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems, Report and Order, PR Docket No. 93-61, 10 FCC Rcd 4695 (1995).

allocating dedicated spectrum to an unlicensed service. The Apple and WINForum Petitions also build upon the Commission's ongoing effort to extend protected, unlicensed services into the millimeter wave bands above 40 GHz.² Together with existing and proposed unlicensed allocations, the 5 GHz unlicensed band would create a set of spectrum options that will promote the full development of unlicensed products and services.

The Petitions reflect broad agreement on the need for a 5 GHz allocation and on the benefits such an allocation would bring to users — in particular, to schools, libraries, rural users, and others unlikely to be served adequately by licensed-wireless and wired alternatives — as well as to the U.S. economy. Apple urges the Commission to move forward expeditiously with a Notice of Proposed Rulemaking.

I. THE APPLE AND WINFORUM PETITIONS DEMONSTRATE THE IMPORTANCE OF A 5 GHZ UNLICENSED ALLOCATION AND MERIT PROMPT FCC ACTION.

A. Individuals Will Require Different Technologies and Services To Satisfy Their Communications Needs.

The NII will combine an array of technologies and service providers, each acting independently, but together capable of serving individuals' varied communications requirements. Prior lines drawn on the basis of industry or technology will blur and, ultimately, disappear as companies compete in new markets (e.g., as cable companies move into telephony and telephone companies into video), as technologies converge (e.g., as wireless links provide the local phone "line" and a DBS satellite provides "cable" service), and what has been considered a single "service" (such as telephone service) is broken down into a host of complementary subsets (such as traditional, wired connections and a range of mobile connections supporting very local, limited range, national, and global communications).

Individual communications — a telephone call, the distribution of a television program, or the transmission of an electronic mail message — will

² Amendment of Parts 2 and 15 of the Commission's Rules to Permit Use of Radio Frequencies Above 40 GHz for New Radio Applications, Notice of Proposed Rulemaking, ET Docket No. 94-124, 9 FCC Rcd 7078 (1994).

combine different technologies and services to create an end-to-end link. Individuals themselves will rely on different technologies at different times, depending on where they are — at home, in the car, at the office, laboratory or school, attending a conference, or traveling across the country or around the world — and on what they are communicating — a data file, a conversation, a graphic image, or a full motion video transmission. Users and service providers will mix-and-match technologies, devices, and services to create offerings optimized for particular applications in price, reliability, scope of service, and enhancements. Each technology will be used for the applications for which it is most efficient and will increase overall demand for all telecommunications services by creating new applications and attracting new users.

B. Wireless Technologies Are An Essential Component of the NII's Overall Mix.

The traditional, wired network will provide the backbone for the NII. Wired offerings will be particularly important, for example, in providing high capacity communications (e.g., telephone and data services) among fixed locations, such as offices, and will continue to be used extensively for “basic” connections to homes.

Many essential applications, however, will demand wireless connections. In particular, wireless technologies will:

- increase mobility — whether inside a home, office, library, or hospital, across town, across the country, or around the world;
- increase flexibility — for example, to create *ad hoc* networks on demand or to reconfigure connections without the costs, delays, and other difficulties associated with re-wiring;
- increase availability — for example, by creating connections in rural, high-growth, and other areas where wired solutions are not readily available or are prohibitively expensive; and
- overcome infrastructure barriers — for example, where asbestos in the walls makes it impossible to install hard-wired connections.

C. Unlicensed Wireless Services Are Key to the Overall Wireless Solution.

The growth of cellular telephone subscribership, the prices recently paid for PCS licenses, the efforts being made to deploy global "Big" and "Little" LEO satellite systems, the demand for MDS, LMDS, and MMDS licenses and spectrum, the success of recently-launched DBS systems, and the enhancements being made to SMR networks to optimize them for new applications, among other developments in the wireless arena, all testify to the range of services that licensed wireless services are expected to provide.

As important as these services will be, they share certain fundamental characteristics that make them ill-suited for some wireless communications applications. In particular:

- Licensed wireless services suffer from the "filter" of a service provider who decides what capabilities the network will support and what capabilities it will not support, based upon aggregate demand within the overall service area. As a result, they cannot be optimized, on a cost-effective basis, to meet the needs of those with unique requirements.
- Licensed wireless services will not (at least in the near term) offer sufficient bandwidth for high-capacity data communications. As a result, they cannot be used for high-bandwidth *ad hoc*, local, or wide area communications, or for high-bandwidth wireless "last link" connections to other networks.
- Licensed wireless services will not be available throughout the country in the near term, or, in some cases, at all.³ As a result, users in rural and other areas will be left far behind unless unlicensed wireless technologies are permitted to develop.

³ For example, broadband PCS licensees with 30 MHz licenses need serve only two-thirds of their service area's population (and that only after ten years); broadband PCS licensees with 10 MHz licenses need serve only one-quarter of their service area's population. 47 C.F.R. § 24.203. The remaining 33%/75% of that population may never be able to obtain service. Moreover, it is unlikely that every PCS license will be awarded in every service area; in areas in which licenses are not awarded, no service will be provided via that spectrum. Of course, some wireless services are inherently nationwide (such as DBS or other satellite-based services); these national services, however, generally do not provide many types of two-way communications nor some types of one-way communications.

- Licensed wireless services will impose airtime charges that will be prohibitively expensive for some users and some types of uses. As a result, many individuals, schools, libraries, hospitals, government entities, and non-profit institutions with high usage requirements (either in terms of time on the network or the bandwidth required), or “marginal” applications,⁴ will be left unserved.
- Licensed wireless services offer limited entry options. As a result, there are substantially more hurdles to overcome (including, in some cases, auctions) and fewer opportunities for new entrants, small businesses, and minority or women-owned businesses, as well as for the development and introduction of new technologies.⁵

Unlicensed services do not suffer from these constraints. In contrast, properly allocated unlicensed, “Part 16” radio services are characterized by:

- **Open entry:** Any manufacturer would be able to sell NII Band devices (as long as the devices conform to some basic “rules of the road” designed to protect equitable access to the shared spectrum resource), and any person may use such a device to communicate with others. There is no licensing process that grants exclusive rights to use the spectrum and, hence, no barrier to the full participation of small businesses and businesses owned by women and minorities.
- **Equal access:** No entity or device can deny others access to the spectrum or grant certain transmissions or users preferential treatment.
- **Innovation:** Due to its “open entry” characteristic and limited technical regulation, unlicensed operation promotes the evolution of technology and the development of new applications.
- **Flexibility:** Because users do not have to obtain licenses, engage in frequency coordination, or hard wire networks, they can communicate

⁴ By “marginal” applications, Apple refers to applications that are of value to users, but are not valued highly enough to justify the fees imposed by a full-service wireless network. For example, the limited mobility provided by a cordless telephone or a wireless modem is of value to users, but few, if any, users would pay cellular telephone rates for this mobility. Similarly, users who can accept some delays in delivery times may prefer a less expensive alternative to a “guaranteed service” telephone network employing dedicated channels.

⁵ The Commission has struggled to provide appropriate opportunities to stimulate the involvement of designated entities in tomorrow’s telecommunications marketplace. That effort has raised a host of difficult questions, in part due to the often overwhelming costs of building a wireless network (as opposed to obtaining the necessary FCC license). The Commission’s efforts have been further complicated by the Supreme Court’s recent decision in Adarand Constructors, Inc. v. Peña, Secretary of Transportation.

on an *ad hoc* basis or, where a more permanent network is desired, they can quickly, easily, and relatively inexpensively design, deploy and reconfigure a network suited to their individual needs. This could be as simple as one computer capable of connecting to the Internet via a wireless modem, or as expansive as a high-bandwidth, community-wide network linking all the schools in a district with the local library system, with local government buildings, or with the broader telecommunications infrastructure.⁶

- **Independence:** Because deployment of unlicensed devices is controlled by end users rather than by centralized network operators, systems can be deployed and operated to meet the users' needs, rather than solely pursuant to a network controller's "needs." Users do not have to wait for a service provider to install a network in their area nor rely solely on the offerings of the local service provider. This "user control" will be particularly important for those in rural areas, who may not see advanced networks being built in their area in the near future, or at all.
- **Spectrum efficiency:** Unlike private networks, unlicensed spectrum is not dedicated to any particular user, but rather can be shared by all users on a dynamic, instant-by-instant, MHz-by-MHz basis. This technique, which is the invariable operating characteristic of the Internet and other data networks, provides the most flexible and efficient means of maximizing the sharing of the spectrum resource.

In addition, with suitable spectrum allocations and appropriate technical rules (such as Apple has proposed for the 5 GHz band), unlicensed spectrum can support higher capacity and longer distance communications.

As a result of these attributes, unlicensed wireless services will complement other wireless services and support users and applications that can not be provided by licensed networks on a cost-effective basis. As NTIA's Administrator stated in a recent letter to Chairman Reed Hundt,

"Wireless connectivity will be essential to support ubiquitous, affordable and adaptable networking capabilities, and it will facilitate

⁶ See Allocation of Spectrum Below 5 GHz Transferred from Federal Government Use, First Report and Order and Second Notice of Proposed Rulemaking, ET Docket No. 94-32, 10 FCC Rcd 4769, ¶ 16 (1995) (unlicensed Data-PCS devices "have the potential to offer a portable 'on-ramp' to the information highway that will be accessible to everyone. The potential for open access to the information infrastructure offered by unlicensed PCS devices will provide benefits, not only to commercial users, but also to individuals and private users.").

many mobile applications. Furthermore, nonlicensed wireless components of the NII will provide significant opportunities for innovators and small companies to make contributions to the overall mix of products and services available through the NII.”⁷

Unlicensed services are not, however, a substitute for licensed-wireless services, any more than a cordless telephone is a substitute for cellular telephone service. The essential attribute of unlicensed operation is that spectrum is available to all users on a non-preclusive basis: no licensee has the right to exclude others or to determine which users or applications will be provided service. As a result, unlicensed operation cannot guarantee the quality of service that characterizes licensed networks. Moreover, it is unlikely that companies will invest the substantial sums required to deploy a general purpose wide area network using unlicensed spectrum any more than a developer would build a building on land to which it has no explicit rights. Unlicensed networks generally will serve individual and niche needs and will not provide the range of offerings provided by licensed-wireless networks.

When unlicensed services reach their full potential, the telecommunications marketplace will not operate exclusively from the “center out,” with all networks and services designed and offered by the owner of a network or a service provider (a telephone company, cable company, competitive service provider, etc.). Unlicensed operation is the antitheses of this centralized view of telecommunications: unlicensed services are telecommunications as seen by, defined by, and structured for an individual user or group of users, *i.e.*, it is the network as seen from the “outside in.”

A useful analogy in understanding the potential of unlicensed services is the customer premises equipment (“CPE”) marketplace. Prior to the deregulation of CPE, telephones were, in every respect, a part of the central telephone network: they were hard-wired to the network; provided, installed, and maintained by the telephone company; and only the telephone company could decide what devices to provide, and at what price. They were also plain, black devices with very limited capabilities and very high costs (for the user). Once the FCC de-coupled CPE from the telephone network and gave individual

7 Letter to Chairman Reed Hundt from Assistant Secretary Larry Irving, ET Docket No. 94-32, ET Docket No. 94-124, PR Docket No. 93-61 (Dec. 12, 1994).

users control over these devices, however, the market was transformed. Without sacrificing in any way the integrity of the telephone network or the financial health of the telephone companies, the Commission created an enormous new market that provides a wide range of products, from high capacity, high-speed office modems, PBXs, and fax machines, to lower-speed modems that connect students to the Internet, to inexpensive home telephones.

Unlicensed spectrum, like the deregulated CPE marketplace, will create the opportunity for manufacturers to offer, and users to deploy, "networks" that fit a wide range of individual needs. In some cases, these may be wireless modems connecting individual computers to the backbone communications infrastructure, enabling schools to move computers (with their connections) from classroom to classroom, or from classroom to home. In other cases, these may be wireless computer-to-computer connections, enabling individuals to exchange data on an *ad hoc* basis across the conference table, the library reference room, or the research center. In still other cases, these may be wireless local area networks ("LANs") tying together the computers in an office or hospital, permitting users to move freely about (for example, from office to conference room to library to the manufacturing floor; or from a patient's bedside to the operating arena to the pharmacy) without losing access to shared resources on the central network (such as electronic mail, databases, medical records and related documents, and the like). In still others, these may be advanced wireless wide-area networks (or "community networks"), connecting buildings in a school system, local government, rural village, or Indian reservation to each other and to the world beyond.

Due to the constraints of traditional Part 15 operation,⁸ unlicensed services have not yet fully matured and, therefore, it is difficult to envision the full scope of the innovations they will make possible. Twenty years ago, few would have predicted the extent to which the introduction of microprocessors and personal computers ("PCs") would transform computing, or the scope and size of today's

⁸ See Apple Petition at 5-6 (discussing effects of operating in unprotected spectrum and the importance of a "Part 16" approach, in which unlicensed devices are treated as a recognized radio service, operate in protected spectrum reflected in a Part 2 allocation, and share frequencies pursuant to access rules that assure equitable sharing of the spectrum resource).

computer market, or how completely computing devices would become integrated into our daily lives.

- Then, only 50,000 computers existed in the entire world; today, 50,000 computers are sold every ten hours.⁹
- Eleven years ago, only 25 percent of workers used computers on the job. By 1993, 47 percent did.¹⁰
- A decade ago, there were only 300,000 registered electronic mail users. In 1993, an estimated 12 million Americans regularly used electronic mail and related on-line services. Today, the number of electronic mail users is estimated to be more than 27 million.¹¹ President Clinton alone receives approximately 20,000 "pieces" of electronic mail daily.¹²

All of these statistics are reflected in worldwide annual computer sales of \$318 billion, with the computer software market contributing an additional \$25 billion annually in earnings.¹³

Unlicensed data communications will do for communicating what the PC and microprocessor did for computing. It will create new applications that are not now envisioned and make possible uses that today either are too expensive or are unavailable in some areas or for some users. It will overcome the tension between portability (placing the power of the computer in the user's hands, wherever the user may be) and networking (linking computers together to give users access to a variety of information resources and other users) by making the

9 National Telecommunications and Information Administration, Office of Telecommunications and Information Applications, U.S. Dept. of Commerce, "Connecting the Nation: Classrooms, Libraries, and Health Care Organizations in the Information Age, Update 1995," at 4 (June 1995) ("NTIA Update 1995").

10 *Id.* at 3.

11 *Id.* at 4.

12 National Public Radio, Morning Edition, "Democracy in America, Part 1," (July 3, 1995). This story discussed more broadly the uses of telecommunications to enhance citizens' ability to communicate with their government representatives through Internet links (26 Senators have a home page on the Worldwide Web), videoconferenced congressional hearings, computerized "town hall meetings," and the like. *Id.* As Senator Leahy said of his use of the Internet, "it's just one more barrier that you tear down between you and the public." *Id.* Yet if telecommunications technologies are not universally available and easily used, they threaten to exacerbate, rather than alleviate, differential access to government representatives and resources.

13 NTIA Update 1995 at 4. According to NTIA, the total annual revenues for the entire telecommunications and information sectors is \$600 billion — or only about double the revenues from computer sales. *Id.* at 3-4.

networking capability as personal and portable as the computer itself.¹⁴ And it will do this for all users — including those who currently are threatened with being left behind by the telecommunications revolution.¹⁵

D. The FCC Must Provide Adequately for Unlicensed Services.

One of the original and still principal functions of the FCC is to assure that the public spectrum resource is used in the public interest. In particular, the Commission assures that the telecommunications infrastructure serves all segments of the population and all regions of the country,¹⁶ that advances in telecommunications technology do not create a society of information “haves” and “have nots,”¹⁷ and that new technologies and services are encouraged.¹⁸

¹⁴ See Apple Petition and Nagel En Banc Statement for a more comprehensive discussion of the existing tension between mobility and networking, and how this can be solved using unlicensed technologies.

¹⁵ At least one press account already has recognized the NII Band’s promise and the parallels between the development of the PC and the development of wideband unlicensed services:

“The visionaries at Apple Computer Inc. are at it again, pushing the envelope of technology, regulatory policy and business development.... Apple has fast-forwarded to a kinder, gentler future where...the unstructured, self-organizing chaos of the Internet is extended to the rigid disposition of the airwaves.... It’s certainly a different model than either the...auction approach or the...lobbyist-take-all system. Think of it as spectrum homesteading, a uniquely American experiment in don’t-fence-me-in, anti-industrial policy.... The petition proposes spectrum sharing by fixed and mobile users on a completely ad-hoc basis. This ‘spectrum etiquette’ is a brilliant blend of good science and free market ingenuity...[which] imposes no centralized control and assumes no traffic prioritization.... [I]f this dream comes true what we’ll...get is an entrepreneurs band [usable by the sort of] real entrepreneurs that hock their cars, quit their day jobs and go for the glory. The kind of people that founded Apple and created the PC industry in the first place. So good luck intrepid infobahn warriors. May your vision become our reality.”

B. Frezza, “Where the I-Way Meets the Skyway,” *Interactive Age* (July 3, 1995).

¹⁶ 47 U.S.C. § 151.

¹⁷ See, e.g., Speech by Reed E. Hundt, Chairman, Federal Communications Commission, Annual Legislative Conference, National Association of Counties, Washington, D.C. (March 5, 1995) (“The information highway is at a crossroads. In one direction lies a society connected by the new audio-video-data technologies; in another direction lies a society further split, this time into information-haves and have-nots. With apologies to Morton Peck, that latter direction should be the road less traveled.”). This important function has also been recognized by both the President and Vice President of the United States. See, e.g., President William Clinton, State of the Union Address (January 25, 1994) (“We must work with the private sector to connect every classroom, every clinic, every library, and every hospital in America to a national information highway by the year 2000.”); Remarks Prepared for Delivery by Vice President Al Gore, Royce Hall, UCLA, Los Angeles, California (January 11, 1994) (the

In order to fulfill its mandate, the Commission must provide adequate, suitable spectrum resources for unlicensed operation. As discussed above, unlicensed wireless services will be crucial in meeting the needs of those who require wireless mobility and flexibility and those whose needs cannot adequately be met on a cost-effective basis by wired or licensed-wireless networks.

The flexible and cost-effective options created by unlicensed technologies will be particularly important in meeting the needs of schools, libraries, hospitals, government entities, and other similar institutions with substantial needs but limited resources. For example:

- **Connecting classrooms and libraries to the NII:** A variety of global, national, regional, and local networks will soon make it possible to transmit huge amounts of information — data, voice, video, graphics, and multi-media — across the state, across the country, or around the world. But while many of these networks will be able to deliver information to a point near the user, very few are well suited to delivering the information to individual users themselves. For example, currently thirty to fifty percent of America's schools have access to the Internet, but only two to five percent of America's classrooms have such access.¹⁹ This is the result of a variety of factors, including cost and infrastructure problems.

Until information can be delivered to, used in, and transmitted from the particular locations in which people study or work, it will be of limited utility. As a result, creating the last, personal link is essential in providing adequate information resources to users. Moreover, because schools and libraries are unlikely soon to have an adequate number of computers and related devices to outfit each classroom or carrel, it will be essential that computing devices (with their connections) be able to be moved about freely and easily from classroom to classroom, or from

Administration must "take action to avoid creating a society of information 'haves' and 'have nots'").

18 47 U.S.C. § 157 ("It shall be the policy of the United States to encourage the provision of new technologies and services to the public.").

19 NTIA Update 1995 at 12 (citing U.S. Department of Education, National Center for Education Statistics, Fast Response Survey System, "Survey on Advanced Telecommunications in U.S. Public Schools, K-12," FRSS 51, 1994). Actual percentages depend on instructional level (elementary or secondary), size of enrollment, metropolitan status (city, urban fringe, town, or rural), and geographic region.

carrel to carrel, in order to maximize the utility of the available resources.²⁰

- **Creating cost-effective solutions.** In many cases, wired and licensed-wireless networks cannot provide cost-effective solutions for public users. For example, some estimates of the cost of hard-wiring classrooms run as high as \$250,000 per school — or nearly \$30 billion dollars to connect each of America's K-12 schools to the NII. "Airtime" charges for licensed-wireless networks run on the order of cents to dollars per minute, depending on the type of user and the time of day.

Efforts are under way to guarantee public institutions capacity on advanced networks at reduced rates.²¹ Even if successful, however, this will be only a part of the solution. Subsidies can be used to reduce rates to designated users, but the underlying costs cannot be avoided altogether — somebody (other ratepayers, shareholders, or taxpayers) must pick up the tab. Moreover, subsidies almost certainly will not make capacity free — they will merely lower rates to a level that is still prohibitive for some users and some applications.²²

Unlicensed services must be part of the solution. They can offer a range of services at substantially lower costs than wired and licensed-wireless networks and, moreover, can provide their users with greater flexibility and control to design and implement networks that meet their unique needs.²³

20 In 1992, U.S. public schools had one computer for every 13 students. Projections suggest that by late 1995, U.S. schools will have approximately one computer for every nine students. NTIA Update 1995 (citing United States Congress Office of Technology Assessment, "Teachers and Technology: Making the Connection," OTA-EHR-616 (Washington, D.C.: U.S. Government Printing Office, April 1995) at 1); *see also* Thursdon, "Laptops Less of a Luxury in Schools," USA Today, p. 8D (April 3, 1995) (the use of laptops in schools is a "growing trend" that "lends versatility to education," although broad access must be assured to prevent this from becoming "an equity issue"; current uses of laptops include loans to students and teachers for in-home use, as well as use on outdoor science projects to enter data and instantly compute results).

21 *See, e.g.*, S. 652, "Telecommunications Competition and Deregulation Act", § 310 (as passed by the United States Senate on June 15, 1995) (reprinted in 141 Congressional Record No. 99, pp. S. 8570, S. 8588 (June 16, 1995)).

22 Commissioner Chong, for example, discussed these issues at a 1994 USTA panel on wiring schools and libraries. As she stated, the single largest issue facing policymakers working to assure that schools and libraries have access to the NII is who will pay the "staggering cost" of connecting the schools, as well as the continuing service costs "once you get students hooked on calling Alaska for information on polar bears?... This is bigger than the FCC, bigger than business, bigger than the states." "USTA Panel on Wiring Schools and Libraries Draws More Questions Than Answers," 14 Communications Daily No. 197, at 4 (October 12, 1994).

23 While the above discussion focuses on the needs of schools and libraries, flexible, cost-effective computing and communicating solutions are also important to other

- **Equalizing opportunities for rural users:** With traditional wired and licensed-wireless networks, users must wait for a service provider to install a network in their area. With unlicensed spectrum, an individual school, school district, university, library system, or hospital could install its own “network” — one designed to meet its particular needs. This option will be particularly important for entities in rural areas, who may not see advanced networks being built in their areas in the near future, or at all.
- **Promoting opportunities for private-public cooperation.** Many companies have demonstrated their interest in helping schools, libraries, and other public institutions obtain adequate telecommunications and computing resources. Because the NII Band would be open to all manufacturers (rather than being controlled by a single licensee or network owner), it would create a host of opportunities for public-private collaboration and would limit a public institution’s dependency on any single provider.

A study released several weeks ago by the Rural Policy Research Institute provides a rare glimpse into the telecommunications needs of rural communities, and confirms many of the basic premises underlying Apple’s Petition — in particular, Apple’s emphasis on the importance of creating technologies that are available without geographic limitation, and on using “community networks” to link residents of rural communities to each other and to the broader information infrastructure.²⁴ The study’s findings include the following:

public institutions, such as hospitals. For example, a recent study by researchers at Harvard University found that in almost two percent all hospital admissions, patients suffered injuries (or death) from complications due to the drugs they were given. According to Lucien Lieb of the Harvard School of Public Health, “We saw the same kind of mistakes being made over and over again by different people in different circumstances, but having a common thread. And the common thread that came out over and over was lack of information.” As a result, Lieb stated, “even very conscientious [practitioners] should have computer systems to catch errors by doctors and nurses. For instance, identifying drugs to which a patient has an allergy, or flagging drug doses that appear too high.” National Public Radio, Morning Edition, “Studies Look Into Causes, Prevention of Hospital Errors” (July 5, 1995). For such systems to prevent the kinds of errors identified in the study, they must be mobile — capable of being taken to the pharmacy, hospital room, and nurses’ station — and available to all the many practitioners involved in patient care.

²⁴ See Rural Policy Research Institute, “Telecommunications and Economic Development in Rural Communities” (June 16, 1995). The study involved twenty rural communications scattered across six states. Only two of the communities involved in the survey had populations above five thousand. See also Rural Policy Research Institute, “Opportunities for Rural Policy Reform: Lessons Learned from Recent Farm

- The “liability of geographic isolation,” which historically has plagued rural areas, still exists but is being overcome by citizens and businesses actively applying new technology. However, “rural areas and small communities [will] fall farther and farther behind urban areas in terms of economic growth and quality of life if telecommunications technology is not fully accessible and utilized.”
- Telecommunications technologies are widely viewed as being “critical to the future growth of rural areas and citizens’ general sense of well-being.” Sixty four per cent of respondents rated telecommunications as important or very important with respect to future economic growth; 55% believed it was important for business retention and for the recruitment of new businesses, and 54% felt it was important for home-based businesses.
- The perceived importance of telecommunications is even greater for services which contribute to quality of life. Almost 76% of the respondents viewed telecommunications as important or very important for educational services, and about 76% regarded it as important or very important for medical services.
- Computer and related technologies are already widely used by individuals in rural areas; technologies linking computers to each other and to information resources are also used, although less widely.²⁵ Businesses also reported widespread use of computers, modems, e-mail, and similar technologies.
- Respondents stated that collaboration among users within communities as well as multi-community collaboration and development may be “very important” to capture the economies-of-size efficiencies which urban areas naturally enjoy.
- Residents of rural communities believe strongly that any community, regardless of size, should have access to the NII. But they do not want

Bills,” prepared for the Senate Committee on Agriculture, Nutrition and Forestry and the House Committee on Agriculture at 10 (April 21, 1995) (discussing importance of ensuring “comparable, reasonable, and market supportable [telecommunications] infrastructure” and of “aggregat[ing] rural demand to permit reasonable access to advanced technology and services”). The Rural Policy Research Institute (“RUPRI”) conducts research and facilitates public dialogue designed to assist policymakers in understanding the rural impacts of public policy choices.

²⁵ Forty six per cent of the residential respondents reported that they use a PC; 25% reported that they use a modem; 15% reported that they use e-mail; 15% responded that they use electronic data transfer; 10% reported that they use satellite data delivery services; and 9% reported that they use electronic medical monitoring.

a handout. There was "strong agreement" among respondents that the costs of new technologies should be paid by those who use them, and respondents "place[d] high emphasis on the private sector and the natural market forces to lead in future telecommunications development."

Similarly, a recent article in *Business Week* described the crossroads facing public libraries. As it stated, "In the coming digital, on-line world, the public libraries will: (a) languish as outdated, expensive artifacts of an earlier age, or (b) adapt and thrive as key resources on the Internet and as public on-ramps to the Information Superhighway." The article described libraries' efforts to take the second path, by digitizing collections for delivery to local, national, and even global audiences; providing public terminals that enable individuals to connect to the Internet; creating on-line collections of hundreds of thousands of pieces of sheet music; and creating electronic card catalogs that index both the library's own materials and material on the Internet. But the article also cautioned that, without needed support, many libraries will be precluded from participating in the NII:

"Many, perhaps most, of the nation's public libraries, though, can only dream of a digital future. The tremendous pressure on municipal and county budgets, which on average provide 79% of a community library's funds, makes it difficult for many of them to simply stay open. Washington contributes only 57 cents per citizen for library spending. And this year, the Commerce Dept.'s National Telecommunications & Information Administration grants, used by several libraries to fund technology projects, have been slashed from \$64 million to \$34 million."²⁶

As the Commission has recognized, it can promote the development of new technologies that will provide cost-effective solutions that cannot otherwise be achieved, when it allocates spectrum for unlicensed technologies. Without action by the Commission, as requested by Apple, the market cannot and will not develop the full potential of the wireless element of the NII.²⁷

²⁶ Verity, "Welcome to the Cy-Brary," *Business Week*, p.90 (May 29, 1995).

²⁷ The Commission's obligation to allocate spectrum in the public interest cannot be "delegated" to an auction. The Commission must use its judgment to determine which spectrum allocations are in the public interest — for example, as it did recently in allocating spectrum for global "Big LEO" satellite systems without relying on an auction. In addition, auctions are particularly unsuited to determining the value of unlicensed spectrum. Market-based mechanisms, such as auctions, universally undervalue public

E. **The 5 GHz Allocation Would Augment Existing and Proposed Unlicensed Allocations and Create a Comprehensive Set of Unlicensed Applications.**

Given the potential of unlicensed communications, it becomes clear, first, that demand for these devices will justify devoting substantial spectrum resources to this service and, second, that allocations in different frequency ranges are appropriate in order to provide a suitable mix of capabilities.

The 5 GHz allocation proposed by Apple and WINForum would augment existing and proposed unlicensed allocations, as discussed in Apple's Petition.²⁸ In particular:

- The NII Band will not be constrained by the cluttered spectrum environment and "at sufferance" operation that characterizes traditional Part 15 operation.
- The NII Band will support substantially higher data rates (scalable as required for a particular activity to as high as 24 Mbps for *each* user sharing the band, or approximately 2.5 times the maximum data rate available for a *single* user utilizing the *entire* Data-PCS band). This will be essential for users requiring higher bandwidth connections, as well as for those operating in crowded areas with a large number of users. The NII Band's higher capacity translates not only into the ability to do conventional tasks more quickly, but also into the ability to do things not previously possible. For example, groups of users in a single building exchanging detailed medical scans or employing high resolution virtual real-time videos could not all use the Data-PCS band at the same time because they would overload its capacity. These

goods (such as unlicensed spectrum) because, by definition, no entity owns the resource (i.e., has the right to exclude others) and, therefore, no bidder or group of bidders has an adequate incentive to pay market value for the resource. It has been suggested that a group of manufacturers could join together and collectively purchase "unlicensed" spectrum at an auction. In such a case, however, the spectrum would lose its essential attribute — it would no longer be open to all users on an equitable, non-preclusive basis, but rather would be "owned" by a group of manufacturers, who might (or might not) permit others to use it for a fee. By analogy, it would be a country club, not a public park. And while country clubs have value (at least to those who can afford to join), they are fundamentally different from public parks. See also House Report No. 103-111 at 253 (auctions are appropriately used only for assigning licenses among mutually exclusive applicants (as opposed to allocating spectrum) and, thus, "would not be permitted to be used for unlicensed uses.").

²⁸ Apple Petition at 11-19.

users could, however, transmit simultaneously using NII Band devices because the total available bandwidth is so far greater (300 MHz compared with 10 MHz).

- NII Band devices will be developed using today's technology. Further technological development will be required before it is possible to manufacture, on a cost effective basis, a wide range of devices operating at substantially higher frequencies, such as the proposed unlicensed millimeter wave frequencies above 40 GHz. The NII Band thus will both provide near-term solutions and spur development of technologies for these higher bands by acting as a "bridge" between existing and proposed allocations.
- NII Band devices will be capable of operating over longer distances than either Data-PCS devices or millimeter wave band devices. Apple strongly believes that unlicensed community networks will be tremendously important in meeting the needs of rural users (including many Native American groups), schools, libraries, and others. Without the capability to communicate over larger distances, however, community networks will not be possible.²⁹
- The 5 GHz NII Band have different propagation characteristics from the millimeter wave bands. In particular, these frequencies are less susceptible to being blocked by walls and, hence, are more likely to be suitable for some in-building applications.
- A 5 GHz allocation will build upon the European HIPERLAN effort, promoting opportunities for interoperability, U.S. technological leadership, and increased U.S. exports.

Some have questioned whether the 18 GHz bands available for licensing under 47 C.F.R. § 94.65(m)(8) could be used to achieve the benefits of the NII Band, thereby obviating the need for an additional unlicensed allocation. For several reasons, they could not. First, these bands are subject to a licensing requirement, which imposes costs and regulatory restrictions on flexible, nationwide use of the band. (This is a particular problem with respect to nomadic communications via *ad hoc* connections.) Second, there is significantly

²⁹ The use of unlicensed devices for longer-distance communications is entirely consistent with the non-preclusive nature of unlicensed services. Through conformance with channel access rules, users will share the unlicensed band on an equitable basis, just as multiple users within a building share unlicensed spectrum. For this reason, unlicensed community networks are not a substitute for licensed-wireless networks or a departure from "true" unlicensed operation.

less total bandwidth available at 18 GHz, and any single licensee is eligible for up to only one 20 MHz frequency pair in any geographic area without making a supplemental showing of need.³⁰ Even if the licensing requirement and related rules were revoked or substantially modified, the 18 GHz band could not replace the proposed 5 GHz allocation because (i) there is only 100 MHz of spectrum available at 18 GHz, (ii) the propagation characteristics of this band make it unsuitable for some of the needs that could be served at 5 GHz, (iii) the 18 GHz band cannot provide HIPERLAN compatibility, and (iv) product deployment could not occur as quickly at 18 GHz as at 5 GHz due to technological and cost barriers.

The above discussion focuses on the unique attributes and resulting unique benefits of a 5 GHz allocation. Each of the other unlicensed allocations, however, also will have its own unique characteristics and, as a result, will be suited to satisfy particular applications.³¹ The question for the Commission is not which unlicensed allocation is "best," but rather what collection of spectrum options will, together, adequately meet the future demand for a full range of unlicensed services.

³⁰ 47 C.F.R. § 94.65(m)(8)(i).

³¹ For example, the Data-PCS allocation will offer opportunities to operate with licensed PCS services, will employ 2 GHz technologies that are widely used and, hence, quite reliable and relatively inexpensive, and a portion of this allocation is available today. As a result, the Data-PCS band likely will gravitate toward somewhat different types of applications from the NII Band, and slight cost differences (such as the per-unit clearing fee applicable to devices deployed in the 1910-1930 MHz band) likely will not materially affect the choices of most consumers. This will occur in much the same way as users today select cordless telephones based on a combination of price and performance (with 900 MHz cordless telephones offering improved performance, but at a higher price). A small number of particularly price-sensitive users, such as schools, will be more attuned to cost differences, and may be more willing to trade off benefits for a reduced price. For this reason, it is essential that the Commission continue to minimize the overhead costs on new unlicensed allocations, for example by allocating relatively clear spectrum for this service.

II. THE FCC SHOULD ADOPT AN NPRM PROPOSING A 5 GHZ ALLOCATION.

A. Prompt Action is Warranted.

The Commission should act promptly to adopt a NPRM and to authorize a 5 GHz unlicensed band, as proposed in the Petitions, for several reasons. First, any rulemaking by necessity will take a year or more to conclude.³² Once the regulatory process is concluded manufacturers require some time to design, develop, test, and deploy new communications products. If NII Band devices are to be available in a timely manner to meet the growing demand for high-bandwidth connections and wireless community networks, action must begin now.

Second, the European HIPERLAN standard is now in the final stages of approval, although HIPERLAN devices are still in the development stages. The United States must proceed with its allocation in order to promote U.S. technological leadership and to assure that the United States is not left in a "catch-up" position. Finally, prompt action will provide greater opportunities to develop technical rules and business plans for the 5 GHz and millimeter wave bands in a manner that capitalizes upon each band's unique capabilities.

B. The NPRM Should Reflect the Many Areas of Agreement Between Apple and WINForum.

The Apple and WINForum Petitions reflect agreement on a range of issues.³³ Most importantly, these entities, both of whom have been actively involved in the development of unlicensed communications and, in particular, in the Commission's unlicensed PCS allocation, have concluded that a 5 GHz

³² For example, Apple, the Commission, and other industry participants together spent nearly four years developing suitable technical rules and identifying suitable spectrum for Data-PCS.

³³ Apple and WINForum developed their proposals independently and, thus, these substantial areas of agreement indicate broad industry consensus. Apple, in particular, has been developing its NII Band proposal since the Administration published its "NII Agenda for Action" in September, 1993. Apple began discussing its NII Band proposal in addresses to industry convocations. From that point on, many people and organizations have contributed to the subject petition, and others are now joining this ongoing discussion through E-mail postings. Similarly, Apple has played key roles in the development of the HIPERLAN standard and, as noted, Apple intends its NII Band description to include the HIPERLAN operating modes that have been endorsed in RES-10.

allocation is required in order to meet certain needs that cannot be met using other available and proposed unlicensed allocations.³⁴ In particular, both Petitions discuss at length the importance of allocating spectrum that will make it possible for unlicensed wireless communications to support broadband applications, including high-speed data, voice, graphics, teleconferencing, videoconferencing, and multimedia applications, via both *ad hoc* and wireless network connections.³⁵

Second, Apple and WINForum each have concluded that an allocation of 250-300 MHz is required.³⁶ Such an allocation will be required to support high bandwidth last, personal, link connections to the Internet and other information resources and to meet the aggregate demand for unlicensed services in high-density areas. In particular, both Petitions agree that the 5 GHz allocation must be capable of supporting data rates of up to approximately 20 Mbps for each individual user.³⁷

Third, both Petitions agree that transmissions should be limited to data encapsulated in packetized form.³⁸ This transmission approach will support a wide variety of service types, including voice and multimedia services.

Fourth, both Petitions agree that technical standards should be developed by an appropriate, representative industry body; that standards should be designed to minimize interference and promote spectrum sharing; and that only certain basic sharing parameters should be specified in the Commission's rules,

³⁴ See Apple Petition at 11-24 WINForum Petition at 5-8, 14-15.

³⁵ See Apple Petition at 15-16; WINForum Petition at 2, 8, 9.

³⁶ WINForum proposed a minimum initial allocation of 250 MHz, with provision for additional spectrum as 5 GHz unlicensed deployment begins on a larger scale. WINForum Petition at 13-14. Apple proposed an allocation of 300 MHz. Apple Petition at 2, 28-29. While the two Petitions identify somewhat different spectrum bands, an adequate 5 GHz allocation — rather than an allocation at the particular identified frequencies — is most important to Apple. Apple identified its 300 MHz NII Band by combining the European HIPERLAN allocation with the existing 5 GHz Part 15/ISM band. Apple believes that this combination offers the greatest potential for building upon existing capabilities, is most consistent with the needs of other spectrum users, and offers the possibility for full duplex operation. If, however, the Commission determines that a single 300 MHz allocation in the lower portion of the 5 GHz band is preferable, Apple would support such an allocation.

³⁷ See Apple Petition at 2, 15-16; WINForum Petition at 8-9, 10.

³⁸ See Apple Petition at 25-27; WINForum Petition at 18-19.

with broader interoperability/compatibility standards left to market forces and industry fora.³⁹

Fifth, both Petitions discuss the benefits of building upon the European HIPERLAN allocation in order to promote U.S. technological innovation and strengthen the competitive position of U.S. companies in European and worldwide markets.⁴⁰

Finally, both Petitions recognize the importance of assuring that an unlicensed allocation is able to meet the unique needs of schools, hospitals, libraries, and other “public interest” institutions. In particular, the Petitions address the need these users have for flexible, mobile, and cost-effective “last links” to the broadband infrastructure. The Apple NII Band petition also addresses the need for wider community networks connecting individual groups to each other and to the NII.⁴¹

C. The NPRM Should Propose Certain Basic Technical and Other Rules.

The NPRM should propose certain basic rules governing operation within the NII Band. In particular, it should provide for:

- **“Part 16” Operation:** The NII Band should be regulated pursuant to a “Part 16” paradigm, in which unlicensed devices are treated as a recognized radio service, operate in a protected spectrum band reflected in a Part 2 allocation, and most importantly, share allocated frequencies pursuant to a set of technical rules designed to ensure that all devices have fair and equitable access to the spectrum. This could be achieved using the same model that was used for the Data-PCS rules — *i.e.*, including a spectrum allocation in Part 2 of the Rules⁴²

³⁹ See Apple Petition at 28; WINForum Petition at 19, 20-21 and n.11.

⁴⁰ See Apple Petition at 3, 16-17; WINForum Petition at 13.

⁴¹ See Apple Petition at 19-24; WINForum Petition at 3-4.

⁴² The Commission has recognized that it may not be necessary to obtain a Region 2 Mobile allocation in order to authorize the NII Band. Preparation for International Telecommunication Union World Radiocommunication Conferences, Report, IC Docket No. 94-31, ___ FCC Rcd ___, ¶ 97 (June 15, 1995) (“it has yet to be demonstrated that an international allocation is necessary to implement [an unlicensed high speed wireless data service] in the U.S.”). Even if the Commission ultimately concludes that such an allocation is necessary or advisable in order to provide NII Band devices with internationally recognized protected status, it could immediately allocate the band on a secondary basis, create a *de facto* protected status within the United States by refraining